

Unreasonable Effectiveness

by Alex Kasman

Amanda Birnbaum began to have second thoughts. Could she really go through with this? Here she was, pacing back and forth in the dry sand on a tiny island she had never even heard of just a few weeks ago. Though it had a small population of people living in modest houses, the island was unclaimed by any country. As far as any one could tell, it was just so insignificant that no country was interested in it. And, here she was, staring through the wrought iron gate of the only really large house on the island without any idea of who might be residing there. But, she knew she was in the right place. Every major scientific publisher had given her the same description of how to find it. They all had stories about this strange address which, for as long as anyone could remember, had been willing to pay any price to subscribe to all of the major research journals.

Well, even if her crazy ideas were wrong, there was something interesting here. Perhaps she could just find out who it was in this place that felt compelled to keep up on the latest published research! So, she walked up the long path winding between the weeds and wildflowers to the front door and she rang the bell.

Faintly, through the thick wooden door, she could hear the sound of the chimes playing a familiar tune to announce her arrival. She felt a sudden urge to run away, but her curiosity won out and she stayed to see whose feet she could hear scuffling slowly towards the door; to see what sort of person lived here.

The door opened to reveal a short, very ordinary looking middle-aged man with blotchy, dark skin and the whitest hair she had ever seen. When he looked up at her face, he was clearly very surprised and took a step back.

“Oh my,” she thought, already comforted by the fact that the man did not look threatening, “he was expecting someone else...I’ve frightened him. I’ll try to explain. I sure hope he speaks English!”

“Dr. Birnbaum!” he said, now gesturing her in, “I was not expecting to see you here. Please, please, come in. Please, come in.”

“You know who I am?!?” she asked incredulously.

“Of course,” he answered shyly, indicating a choice of comfortable seating options from a stuffed sofa to a captain’s chair. “And why wouldn’t I know who you are? Why, everyone is talking about you. Your Ph.D. thesis was published less than one year ago in *Memoirs of the American Mathematical Society* and already has had a profound impact in theoretical biology as well as in your own

area of high-dimensional topology. It was brilliant, truly brilliant. I read it myself! Let me get you some tea.”

He disappeared through a slender, arched doorway at the back of the room in which she was sitting, giving her a moment to think. If there had been any lingering doubt that she was in the right place, his behavior had eliminated it. She was also glad that he had leapt right into this topic of conversation, since she was never sure how she could bring it up without sounding crazy.

“Yes,” she called to the other room, “that is what I had come here to talk to you about.” There was no reply, and so she supposed that he could not hear her.

When he returned a few minutes later, he was carrying a silver tea set.

“Ah, *camelia*,” he said, sniffing at the fragrant aroma of the tea as he served. “But, I don’t understand, why would you come all of this way to talk to me about your work? You can’t possibly know who I am!”

“It’s not just my research that I want to talk to you about, it is math research in general.” Amanda stirred her tea, but did not even lift the cup off of the saucer. She had no interest in the tea just now. “Back when I was an undergraduate, one of my professors had defined mathematics as ‘the study of necessary consequences of arbitrary axioms about meaningless things.’ My classmates and I, all math majors, did not like this description. It seemed to ignore the *usefulness* of mathematics. After all, math is used in engineering, physics, biology, economics, you know. We had a discussion, about this paradox. ‘If mathematics begins with these meaningless abstractions, why is it that it turns out to be so useful in the end?’ There were lots of different opinions on the subject.”

“Oh yes,” he chimed in with a bright smile, “I’ve heard such debates before many times. ‘The Unreasonable Effectiveness of Mathematics’! ‘Why is it that results in abstract mathematics, constructed without any thought given to the real world, some time later turn out to be useful after all?’”

“Right! Right. Like non-Euclidean geometry. At the time it was first suggested, it was just a sort of trick. ‘Look what we can do if we pretend that parallel lines meet too!’ But then, after Riemann, Clifford, Hilbert and Einstein it’s no longer a joke, it is a description of the universe we live in, though we never knew it before.”

“And,” he added, clearly enjoying this conversation, “what about the use of non-commutative rings and imaginary numbers in particle physics?!?”

“Yes,” she agreed, “when imaginary numbers were first discussed by mathematicians they were barely even considered to be real mathematics. Now physicists regularly consider quantum wave functions which are complex valued with no qualms.”

“And when the physicists first found non-commutativity in their measurements,

the supposedly useless theory of abstract algebra was already there, instantaneously transformed into a branch of 'applied' mathematics!" He laughed so hard that she *did* begin to get frightened. He noticed her reaction, and tried to calm himself down, slowly sipping at his tea and trying not to laugh.

"I'm sorry," he said, "I have not had this conversation for quite a long time and...and I have a special interest in it. Oh, but you had something to say and came such a long way. Perhaps I should just let you talk."

There was an uncomfortable pause while she tried to collect her thoughts and her courage.

"So," she continued, "when my friends and I discussed these ideas in college there were two main viewpoints. Some argued that mathematics allows us to study any structured system, and then since the universe seems to have *some* rules to it, we obviously will be able to use math to say things about it somehow."

"Hmmm," he hummed while nibbling on a sugar cookie.

"And the others all thought that the universe is way beyond our comprehension anyway. According to them, when we have a new mathematical idea, we apply it to the universe because we have nothing better to use."

"Ah," he said swallowing, "as they say: to a man whose only tool is a hammer, everything looks like a nail!" Remembering that he had promised to be silent, he stopped suddenly, 'zipping' his mouth shut with his thumb and forefinger.

"Right. But, I had another idea. It was so crazy, I didn't even mention it to my friends, but I kept it in mind as a sort of joke." She waited for him to ask what the crazy idea was, but he just smiled and looked down at the table, as if he knew she was talking about him.

"My idea," she continued, "was that another good explanation for why 'pure mathematical' research becomes useful some time after its discovery is that the universe itself changes to fit our mathematical discoveries."

"Oh," he said, suddenly blinking rapidly while still smiling. "And why have you come all of this way to talk to me about it?"

"Because, I think you're the one who is doing it."

He nodded slowly, as if admitting it was true. This surprised her, since she had expected a denial. She had expected to be told that she was crazy. It was a crazy idea, after all...wasn't it?

There was another uncomfortable silence.

"So," she said sharply, "it's *true*?"

"Between you and me?" he looked back and forth as if he expected to find people eavesdropping right there in his living room. "Between you and me, it is, and it is a thankless job."

“So, does that make you...you know...are you...the creator of the universe?”

“Ha!” he shouted so loudly that she almost spilled her tea. “If I were one of the creators, you think I’d be here on *this* crazy little planet in the middle of nowhere? No offense intended. No, no, I’ve just been doing this here for a few hundred years and after two hundred more I can retire to a nice alternate reality I’ve been dreaming of.”

She was still trying to process all of this. “So, you mean whenever we make a discovery the whole *universe* changes?”

“Well, not quite the *whole* universe, and not quite every discovery. When I find a result that I find especially interesting or entertaining, I find some way to incorporate it into the universe...but only locally. That’s why your cosmologists have been so confused in their theories. In other districts, those with my job may have different tastes in math, different ideas of how ‘reality’ could be. In fact, it is this diversity of possibilities that the creators enjoy most...it’s why I have a job!” He was very happy to have someone to talk to about this after being silent for so long. A smile of contentment shone on his face and he leaned back in his seat as if he had never been so comfortable in his life.

“But then,” she had so many questions, she found it difficult which to ask first, “if...”

“Wait!” he interrupted sitting up straight with a worried expression. “Amanda, please, you must tell me how you found me out. I am not supposed to be discovered, you know.”

“Well,” she said, unable to look him in the eye, “you remember my thesis?”

“Very well!” His eyes lit up in a way she found flattering. He had clearly liked her work. “You noticed that the cohomology of a certain class of high-dimensional manifolds had some bizarre algebraic properties. Because the behavior reminded you of immune systems in biology, you called such manifolds ‘immunity manifolds’. Although you say in the introduction that you are not an expert in biology, the idea motivated your nomenclature throughout the thesis. Some immunity manifolds are healthy, some are not. Some even have auto-immune diseases!”

“Just names I gave them to help me describe and understand the mathematical structure. I was doing math, not biology.”

“Perhaps, but your scientists were never able to make sense out of the immune system before and there was so much room for rich and beautiful discoveries to grow out of your theories. I just couldn’t wait to get to work on it. You must have seen by now how I was able to bring it to play on some questions regarding the improvement of vaccinations and in just a few months some medical researchers

working on the disease scleroderma will discover that they can use Serre duality to..."

"But," she interrupted, "you made a mistake. I mean, I made a mistake. I was wrong about equation 3.6. The microchimeric subalgebras don't have to be simply connected, and so definition 3.9 just didn't make any sense and..."

"No," his jaw fell open and he dropped the last little piece of his cookie. "Not equation 3.6! But that was one of my favorite parts. I used that everywhere!"

"Yes, I know. That is how I found you. You see, I caught the mistake just after the Memoir was published. It wasn't easy, but I was able to make sure that every copy with the mistake was collected unread and replaced with a corrected version...every copy except the one that was sent separately by private courier here to your house. And that is how I knew..."

"Oh my," he said, stirring his tea vigorously. "Oh my, how careless of me! We will have to do something about that, won't we? Yes, something will have to be done about that."